Exploring the limits of *in situ* Rb-Sr dating by LA–ICP–MS/MS

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The Rb/Sr isotopic system is a useful tool for constraining the timing of magmatic and metamorphic events. The ability to obtain *in situ* $^{87}Rb/^{86}Sr$ ages has typically been limited by the isobaric overlap of ^{87}Rb on ^{87}Sr. Simultaneous use of reactive gases such as N_2O with a LA-ICP-MS/MS, now facilitates in situ Rb/Sr dating [1,2]. The reaction of N_2O with Sr and not Rb means that a simple mass shift approach can be used to separate $^{87}Rb^+$ and $^{87}Sr^{16}O^+$ online.

The precision of this technique is largely dependent on the laser system and ICP–MS/MS conditions used, and these parameters are yet to be fully explored. We investigate the effect of laser wavelength (213 vs. 193 nm), pulse repetition rate (5 vs. 10 Hz), and reaction gas flow, on the oxide production and sensitivity of Rb and Sr using an Agilent 8900 ICP–MS/Ms coupled to a Teledyne photon–machined LSX–213 and G2+ laser system both equiped with an HeLex cell. These analytical conditions have been tested on commercially available reference materials including Mica–Mg, BHVO-2G and NIST SRM 610 and 612 and on phlogopite, amphibole, clinopyroxene, apatite and feldspar macrocrysts, for which Rb, Sr and $^{87}Rb/^{86}Sr$ homogeneity have been tested.

Our preliminary results show that, Rb/Sr ages can be obtained with uncertainty between 2 to 4%, even for limited Rb/Sr fractionation (e.g. $0 < {}^{87}Rb/^{86}Sr \leq 10$ in amphibole for instance) and even for rocks younger than 300 Ma. We find however, that the main draw–back of this technique is to retrieve an accurate $^{87}Rb/^{86}Sr$ ratio. Indeed due to the production of Sr-oxide, the measured ratio is $^{85}Rb/^{86}Sr^{16}O$ which must be corrected back to the "true" $^{87}Rb/^{86}Sr$. However, the correction applied varies significantly within and between runs and is clearly mineral/sample dependant. This variability may reflect a matrix–dependent oxide–production and/or ionisation efficiency and/or ablation–yield, or unaccounted interferences on mass 85. These issues need to be further investigated to improve the precision and robustness of the *in situ* Rb/Sr ages obtained.

[1] Zack & Hogmalm (2016), *Chemical Geology*, 120–133
[2] Hogmalm *et al*. (2017), *J. Anal. At. Spectrom.,* 305–313